

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Cement)

Fatal Exploding Vessel under Pressure Accident
May 31, 2004

Service Transport, LLC (K536)
Franklin, Simpson County, Kentucky

at

Essroc Cement Corp.
Essroc
Sellersburg, Clark County, Indiana
Mine I.D. No.12-00066

Investigators

Kenneth W. Diez
Mine Safety and Health Inspector

James L. Angel
Mechanical Engineer

Originating Office
Mine Safety and Health Administration
North Central District
515 West First Street, Room 333
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Steven M. Richetta, District Manager



OVERVIEW

On May 31, 2004, Danny Lee Johnson, contract truck driver, age 47, received burn injuries when he was sprayed by diesel fuel after a hose separated from a quick connect fitting. He was attempting to pump-off diesel fuel from a fuel truck tank to a quarry fuel tank. Johnson received second and third degree burns and died on June 14, 2004.

The accident occurred because the procedures and/or equipment used to off-load the diesel fuel from the tanker truck were inadequate. The diesel fuel flow from the truck's pump to the quarry tank was blocked, resulting in the development of higher than normal pressure. The diesel fuel heated in the hose as the pump recirculated the fuel through its internal relief valve. The higher than normal pressure, combined with the diesel fuel's high temperature, and possibly a contributing force from pulsation of the pump, caused the hose to slip off the fitting.

The blocked flow could have occurred if the inlet valve to the quarry tank was in the closed position or if the inner liner of the discharge hose separated.

GENERAL INFORMATION

The Essroc mine, a surface cement operation, owned and operated by Essroc Cement Corporation, was located in Sellersburg, Clark County, Indiana. The principal operating official was Gerry W. McKervey, plant manager. The mine normally operated, 24 hours a day, seven days per week. Total employment was 197 persons.

Limestone was mined from multiple benches and hauled by truck to the primary crusher. The material was transported by conveyors to the plant where it was milled and mixed with other materials to produce cement. Finished products were sold for use in the construction industry.

Makowsky Oil Company, located in Jeffersonville, Indiana, was a supplier of diesel fuel to Essroc Cement Corporation. The principal operating official was Roger C. Makowsky, president.

Makowsky Oil Company contracted Service Transport, LLC to transport and deliver diesel fuel to the Essroc mine several times a week. The principal operating official for Service Transport, LLC, located in Franklin, Simpson County, Kentucky, was Charles L. Key, chairman.

The last regular inspection at this operation was completed March 2, 2004.

DESCRIPTION OF ACCIDENT

On the day of the accident, Danny Lee Johnson (victim) arrived at the plant to deliver diesel fuel at approximately 6:00 a.m. Johnson went to the kiln diesel fuel storage tank and pumped-off 5,500 gallons of diesel fuel without any problems. He then drove to the quarry diesel fuel storage tank located near the crusher building. During the off-loading of diesel fuel at the quarry, the hose separated from the quick disconnect fitting located at the pump's outlet side. Heated diesel fuel sprayed out of the hose, contacting Johnson.

Johnson used his cell phone to call his wife and also reported the incident to a Service Transport terminal dispatcher. The dispatcher contacted Makowsky Oil Company and asked Roger C. Makowsky, president, to call for emergency medical assistance. Makowsky went to the mine to assist.

Samuel A. French, leadman/truck driver, and Dennis L. Smith, crusher operator, were traveling to the primary crusher building when they saw Johnson sitting next to the truck cab. French contacted the plant control room kiln operator requesting emergency medical assistance. Local police and emergency personnel arrived. Johnson was transported to a regional hospital where he died on June 14, 2004.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident on June 17, 2004, at 4:10 p.m., by telephone from Gerry W. McKerverey, plant manager, to Steven M. Richetta, district manager. An investigation was started June 21, 2004.

MSHA's accident investigation team traveled to the mine, conducted a physical inspection of the accident scene, interviewed employees, and reviewed documents and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management, the miners' representative, employees, and representatives of Makowsky Oil Company and Service Transport, LLC.

DISCUSSION

Location of the Accident

The accident occurred at the quarry diesel fuel storage tank. The tank was located in an open area near the crusher building. The ground surrounding the tank was relatively flat.

Weather

The weather conditions at the time of the accident were cloudy with a light mist and a temperature of 68 degrees Fahrenheit.

Quarry Fuel Tank

The 10,000 gallon capacity quarry fuel tank was placed in service about 1972 and relocated to its present location in 2000.

The quarry tank inlet pipe was equipped with a rising stem gate valve used as a shut off valve for the tank. The handle rose from an approximate 1-3/4 inch height to a 4-3/4 inch height above the valve body from the fully closed to the fully opened position. Approximately 2-1/2 inches of the lower part of the stem was a bright brass color when the valve was fully opened.

Reportedly, the valve on the quarry tank was found in the closed position by personnel who responded to the accident scene. The gate valve at the quarry tank was disassembled and inspected. No defects were found and the gate valve opened and closed fully. A check valve located between the gate valve and the quarry tank was also disassembled and inspected and no defects were found. No sludge or debris was found in either the gate valve or the check valve.

A clock-type gage, manufactured by Morrison Brothers Company, was found on the top of the tank approximately 12 feet above ground level. The gage's small

hand read feet and the large hand read inches. Morrison Brothers literature stated the gage could be read within 1/8 inch from a distance of 20 - 30 feet. The clock gage head swiveled. The investigators observed that the gage face was squarely facing the quarry tank inlet (toward the fuel trailer). When the operation of the gage was observed, it did not respond immediately as fuel was pumped into the tank but did start to move and indicated fuel was filling the tank. Corrosion on the surfaces of the gage's fitting indicated that the gage had been in place for some time.

Fuel Transfer Pump

The fuel transfer pump, Model 3622, Type 3, Specification No. 10040, was manufactured by Roper Pumps on April 25, 2001. The manufacturer's manual (IGP-3622, 1995) specifications listed the pump maximum speed at 750 rpm, maximum pressure at 125 psi, fuel oil flow at 600 rpm with 50 psi at a rated discharge pressure of 127 gal/min, fuel oil flow at 1000 rpm with 50 psi at a rated discharge pressure of 215 gal/min, and port connection at 3 inches National Pipe Thread (3" NPT). The pump contained an internal relief valve designed to protect the pump from a momentary pressure spike.

The relief valve setting screw was measured and found to extend 1.438 inches from the case. The Roper manual specified that the maximum outward adjustment of the setting screw (lowest pressure setting) was 1.75 inches; therefore, the relief valve would not have been at its lowest setting at the time of the accident.

Quick Disconnect Fitting

The fitting, a quick-disconnect type, was a coupling half, female by hose shank, Model Kamlok 633-C-3 (current model No. 633-AL30) manufactured by Pride Cast Metals, Inc. The Kamlok fitting, constructed of aluminum material, was designed to withstand a hydrostatic test pressure of 300 psi and a minimum working pressure of 150 psi. The fitting was manufactured to military specifications MIL-C-27487G and A-A-59326. Measurements of the fitting were taken and compared to the specification dimensions. No out-of-tolerance dimensions were found. The age of the fitting could not be determined.

The fitting functioned by inserting it over a male coupling half. Two cam arms, one on each side of the female coupling, were then rotated in line with the axis of the female coupling. A cam at the pivot end of the cam arm engaged a slot in the male coupling to seal and secure the two couplings together.

Hose

The hose, Model ST 120LT, was manufactured by the Kanaflex Company. The hose measured 3 inches inside diameter (3" I.D.) and was approximately 12 feet long. According to manufacturer specifications, this hose had a -30°F to 140°F

temperature range and a working pressure of 65 psi. This hose was designed to be used as a gasoline tank truck gravity drop hose. The manufacturer reported that the hose wasn't designed for pump-off applications and stated that the cycling of pumps could cause the hose to expand and contract, eventually allowing the hose to "walk" off the fitting. The hose was discarded before the investigation started.

The hose was secured to the barbed shank end of the fitting with two metal bands. Each band was secured with a clip that was crimped onto the band. Service Transport, LLC personnel stated that most of their hoses, complete with attached fittings, were purchased from Southern Kentucky Maintenance. However, the origin of the hose and quick-disconnect fitting assembly involved in the accident could not be determined.

Photographs of the hose components taken immediately after the accident indicated that several assembly defects existed with the coupling. The two bands that secured the hose to the coupling were not properly positioned in relation to the barbs on the coupling. The bands were positioned too high up and were too close to the female end of the coupling. In this position, the bands did not properly engage the barbs on the hose coupling. This situation could cause the hose to slip off the fitting at a lower pressure than when installed properly. The clips securing the bands were positioned on the same side of the hose. The clips should have been spaced 180° apart to prevent leaks.

Delivery Truck

The fuel was off-loaded from a diesel fuel tanker truck owned by Service Transport, LLC. It was a 1998 Freightliner tractor with a 7600 gallon rated diesel fuel (8500 gallon gasoline) capacity tanker trailer. There were no flow or pressure gages on the truck and no relief valves or high temperature monitoring devices installed in the discharge line.

Fuel was typically off-loaded by the operator of the truck using the truck's engine speed and pump. The truck engine was operated at idle and the pump was

engaged by depressing the clutch and engaging the power take off (PTO) in the truck's cab. As fuel began to flow, the operator would return to the truck cab and set the engine speed to 1000 rpm using the truck's cruise control.

Training and Experience

Johnson had one month and four days experience with Service Transport, LLC. He had 10 years trucking experience but did not have any mining experience.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following causal factors were identified:

Causal Factor - The procedures and/or equipment used to off-load the diesel fuel from the tanker truck were inadequate.

Corrective Action – Service Transport, LLC should ensure that the procedures and equipment are adequate to safely off-load fuel from the fuel tanker truck. The operator of the truck should be trained to identify any improper or malfunctioning equipment and report these conditions to management.

Causal Factor - Service Transport, LLC management policies, standards, and controls had not been established to ensure that persons off-loading diesel fuel from delivery trucks were adequately protected. Employees were trained to operate the pump beyond its rated speed.

Corrective Action - Service Transport, LLC management should develop procedures to ensure that persons off-loading diesel fuel from delivery trucks are adequately protected. Employees should be trained to operate the pump within the speed recommended by the pump's manufacturer.

Causal Factor - The fuel discharge system for the tanker truck was not equipped with safety devices that addressed excessive operating pressures or temperatures.

Corrective Action - Service Transport, LLC management should develop standards that address the hazards associated with operating the fuel discharge system at excessive pressures or temperatures. As required by the pump manufacturer, relief valves should be properly installed to prevent excessive pressures or temperatures. These devices should be tested frequently and replaced when they are not operating properly.

Causal Factor - Service Transport, LLC management policies, standards, and controls had not been established to ensure that the equipment used to off-load diesel fuel from the delivery truck was properly installed and compatible with the task being performed.

Corrective Action - Service Transport, LLC management should develop standards that require fuel discharge hoses, manufactured and properly tested for pump-off applications, be used. The hoses and the associated couplings should be inspected by competent persons and replaced when deficiencies are found.

CONCLUSION

The accident occurred because the procedures and/or equipment used to off load the diesel fuel from the tanker truck were inadequate. The diesel fuel flow from the truck's pump to the quarry tank was blocked, resulting in the development of higher than normal pressure. The diesel fuel heated in the hose as the pump recirculated the fuel through its internal relief valve. The higher than normal pressure, combined with the diesel fuel's high temperature, and possibly a contributing force from pulsation of the pump, caused the hose to slip off the fitting.

The blocked flow could have occurred if the inlet valve to the quarry tank was in the closed position or if the inner liner of the discharge hose separated.

VIOLATIONS

The following citation was issued to Service Transport, LLC.

Citation No. 6183125 was issued on April 4, 2005, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 56.14205:

An accident occurred at this mine on May 31, 2004, causing injuries that resulted in the victim's death on June 14, 2004. A contracted fuel delivery driver suffered second and third degree burns when he was sprayed with heated diesel fuel. The fuel discharge hose, connecting the truck mounted pump and a mine site storage tank, separated from a connection fitting during pumping. The manufacturer of the fuel discharge hose specified that the particular model hose being utilized was designed for gravity discharge of gasoline and was not intended for pumping applications. According to the hose manufacturer, the use of pumps with gasoline gravity drop hoses causes expanding and contracting forces to the hose and can result in the hose "walking" off or separating from the fitting. Separation of the hose and fitting during pumping would result in fuel being discharged from the system and spraying onto persons in its path.

The citation was terminated on April 7, 2005, when hoses designed for pump-off applications were purchased and placed into service. Delivery drivers were trained to identify the hazards associated with the use of improper equipment.

Approved by:

Date: April 11, 2005

Steven M. Richetta
District Manager
North Central District

APPENDIX A

Persons Participating in the Investigation

Essroc Cement Corporation

Gerry W. McKervery	plant manager
Bruce B. Springer	safety manager
David Johnson	quarry foreman
Jack E. Wampler, Jr.	miners' representative

Service Transport, LLC

Michael W. Youravich	terminal dispatcher
Robert W. Arthur	terminal manager
Larry D. Love	truck driver

Makowsky Oil Company

Roger C. Makowsky	president
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Indiana Department of Labor-OSHA

Kyle Slade	industrial hygienist
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Mine Safety and Health Administration

Kenneth W. Diez	mine safety and health inspector
James L. Angel	mechanical engineer